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(54) **HIGH AVAILABILITY FOR CLOUD SERVERS**

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USPC 707/639, 652, 634, 646, 769, 692, 813, 707/618, E17.014, E17.01, E17.007, 707/E17.005, 737, E17.089; 711/162, 216, 711/118, 154, 159, 170, 171, 168, 112, 173, 711/103, E12.008, 6, E12.065, E12.002, 711/E12.022, 153, E12.103, E12.001, 711/E12.84; 714/15, 37, 45, 19, 27, 714/E11.025, 35, E11.029, E11.174; 718/1, 718/100, 104, 1.102; 709/226, 203, 213, 709/231, 227, 223, 224, 225
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,973,646 B1 * 12/2005 Bordawekar et al. 717/146
7,779,295 B1 * 8/2010 Shah et al. 714/6.32

(Continued)

FOREIGN PATENT DOCUMENTS

WO WO2012067964 A1 5/2012

OTHER PUBLICATIONS

Pavel Segec and Tatiana Kovacikova—"A survey of open source products for building a SIP communication platform"—Published in: Journal Advances in Multimedia archive—vol. 2011, Jan. 2011 Article No. 5—pp. 1-21.*

(Continued)

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(57) **ABSTRACT**

A high availability system in a cloud computing environment includes a snapshot manager disposed in a mirror environment having at least one computer server and a plurality of virtual machines disposed in a production environment. Each of the plurality of virtual machines includes a snapshot agent configured to perform a method. The method includes periodically taking snapshots of the virtual machine associated with the snapshot agent, determining a delta image based on a change between a current snapshot and a previous snapshot, removing previous snapshots in the virtual machine and transmitting the delta image to the snapshot manager. The snapshot manager is configured to store a recovery image for each of the plurality of virtual machines and to merge the received delta image with the recovery image to update the recovery image.

4 Claims, 7 Drawing Sheets